

DEVICE FOR PROTECTING A CONTAINER AND CONTAINER  
EQUIPPED THEREWITH

5 The present invention relates to a device for  
protecting a container and to a container equipped with  
this device.

10 It has become commonplace for use to be made of com-  
posite materials in order to produce containers  
intended to contain a fluid under pressure. These  
containers may be vats, tanks or bottles, and may be  
made in particular of glass, aramide or carbon fibers  
embedded in a matrix. This type of container generally  
comprises a cylindrical side wall and rounded ends,  
15 commonly known as "domes", and a connecting piece  
located at the top of one and/or other of the domes.

20 These composite materials have numerous advantages for  
this application but do, however, have the disadvantage  
of having highly varying resistance to knocks and  
droppages of the containers, depending on the nature of  
the fibers used. In particular, containers produced by  
carbon-fiber filament winding are highly sensitive to  
such knocks or droppages.

25 The bases of the domes are the thinnest parts of the  
wall of a container and are therefore the weakest. A  
knock on or droppage onto one of these domes produces  
delamination of the internal layers of composite  
30 material, which leads to a drop in the mechanical  
ability of the container to withstand the pressure of  
the fluid and therefore leads to a risk of this  
container bursting.

35 To solve this problem, it has been envisioned, for a  
container obtained by winding fibers, to place a  
protective insert made of a knock or impact absorbing  
or deadening material, particularly polyurethane foam,

on each dome of this container, then for this insert to be covered with an external winding of reinforcing fibers embedded in a matrix.

5 This method is satisfactory on the whole, but retains various drawbacks, namely:

- increased winding time;
- insert-covering layers which constitute additional
- 10 material which plays no part in the ability of the container to withstand the pressure of the fluid and which make this container heavier;
- a thinning of the insert at its ends, that is to say toward the side wall of the container on the one hand,
- 15 and toward the top of the dome on the other hand, to allow this insert to be covered over without the covering layers experiencing breaks in level; this insert therefore protects the container essentially against "oblique" droppages, that is to say droppages
- 20 where the axis of the container makes an angle of about  $45^\circ$  with the impact surface, but affords this container practically no protection against knocks on the top of the dome, in the case of a "vertical" droppage, that is to say a droppage where the axis of the container is
- 25 roughly perpendicular to the impact surface, or against knocks on the portion of the container side wall adjacent to the base of the dome, in the case of "horizontal" droppage, that is to say a droppage where the axis of the container makes a small or zero angle
- 30 with this same impact surface.

Either one of these two types of droppage therefore carries the risk of causing the aforementioned internal delamination of the base of the dome.

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The present invention sets out to overcome these drawbacks by providing a protective device which is simple and inexpensive to implement, does not make the container significantly heavier, and affords this

container perfect protection in the event of droppage, regardless of the angle that the axis of this container makes with the impact surface.

- 5 To this end, this protective device comprises:
- a shell made of a puncture-resistant material, shaped to envelope at least the entirety of a dome of the container, delimiting a space between its interior face and the exterior face of the wall of the container (1);
- 10 and
- a compressible material capable of deadening a knock or impact, filling the entirety of the aforementioned space.
- 15 This device is therefore produced independently of the container, that is to say without fitting a protective insert and winding fibers round it when manufacturing the container. As a result of its shape which envelopes at least the entirety of the dome, and as a result of
- 20 the space between said shell and the wall of the container being completely filled, the device spreads perfectly uniformly the impacts that the container may suffer, with the compressible material possibly compressing in order to deaden this knock at the time
- 25 of this impact.

What this means is that this device allows the dome of the container to be protected efficiently regardless of the angle formed, at the time of impact, between the

30 axis of this container and the impact surface.

The shell may be made in particular of synthetic resin, particularly of thermoplastic resin such as acrylonitrile-butadiene-styrene or polycarbonate, while

35 said compressible material may be expanded polystyrene, a polyurethane or polyethylene foam, or any other expanded synthetic material.

Advantageously, the device is shaped to cover not only

the entirety of the dome of the container but also the portion of the side wall of the container that is adjacent to the base of this dome.

- 5 The enveloping of this portion enhances the protection of the container against "horizontal" droppages.

The device may have a roughly constant thickness, that is to say that the shell may thus "follow" the wall of  
10 the container; however, as a preference, this shell has, at the end corresponding to the side wall of the container, a wall roughly parallel to the axis of the container and, at the end corresponding to the top of the dome of the container, a wall perpendicular to this  
15 axis, these two walls meeting in the form of a rounded zone.

Through this shape, the device has a thickness which is markedly increased where it faces the thinnest part of  
20 the dome, this further improving the protection afforded to the container against "oblique" droppages.

Advantageously, when the device is intended to equip a container comprising a connecting piece situated at the  
25 top of a dome, it comprises an annular projection, the height of which is such that it extends beyond the free end of this connecting piece when the device is placed on this dome.

- 30 In the event of a "vertical" droppage, this projection makes it possible to perfectly protect the connecting piece against any direct impact.

The device may be fixed to the container non-removably,  
35 by any appropriate means, for example by bonding; it may equally be mounted removably on this container, so that the wall of the latter can be periodically inspected.

According to one preferred embodiment of the invention which can be used on containers comprising a connecting piece, this connecting piece is threaded at its free end and the device is shaped to surround this  
5 connecting piece in such a way that the exterior face of the shell is set back from the threaded free end of the connecting piece, and comprises a tapped ring which can be screwed onto said connecting piece and bear against said shell in order to mount the device on the  
10 dome.

To allow a good understanding thereof, the invention is described once again hereinbelow with reference to the appended schematic which, by way of nonlimiting  
15 example, depicts one preferred embodiment of the device to which the invention relates.

Figure 1 is a half view thereof when it is mounted on a tank, in longitudinal section, and  
20 figures 2 to 4 are views thereof in longitudinal section on a smaller scale, in the event of, respectively: (i) a "vertical" droppage, that is to say where the axis of the tank is roughly perpendicular to the impact surface at the time of the impact, (ii) an  
25 "oblique" droppage, that is to say where this axis makes an angle of roughly  $45^\circ$  with said impact surface at the time of the impact, and (iii) a "horizontal" droppage, that is to say where this axis forms a small or zero angle with said surface at the time of the  
30 impact.

Figure 1 depicts part of the side wall 1a and of the rounded end 1b, known as a "dome", of a tank 1 made of composite material, this tank being fitted with a  
35 device 2 for protecting its wall against knocks or droppages.

The tank 1 is of the type intended to contain a fluid under pressure, and comprises of wall 5 made of

composite material, an interior lining wall 6 and a metal connecting piece 7 for connecting this tank 1 to the installation that needs to be supplied with fluid.

- 5 The connecting piece 7 comprises a tubular part 7a, which is threaded and tapped at its free end, and a circular base 7b. The tapping in the part 7a allows the aforementioned connection while the thread allows the screwing-on of a tapped ring 8 for removably mounting  
10 the device 2 on the tank 1. The base 7b is sandwiched between the walls 5 and 6 to make sure that the connecting piece 7 is mounted firmly on the tank 1.

- The device 2 comprises an external shell 10 which  
15 envelopes the entirety of the dome 1b and a portion of the wall 1a adjacent to the base of this dome 1b, and a filling 11 made of a compressible material occupying all of the space delimited by the exterior face of the wall 5, the part 7a of the connecting piece 7 and the  
20 interior face of the shell 10.

- The latter is made of a puncture-resistant material, particularly a thermoplastic resin such as acrylonitrile-butadiene-styrene or polycarbonate. At the end  
25 corresponding to the wall 1a, it has a wall 10a roughly parallel to the axis of the tank 1 and, at the end corresponding to the top of the dome 1b, it has a wall 10b perpendicular to this same axis, these walls 10a and 10b meeting in a rounded region 10c. The result of  
30 this structure is that the filling 11 is thick where it faces the part of the dome 1b at the end corresponding to the wall 1a, in which part this dome 1b has its smallest thickness.

- 35 The shell 10 further comprises an annular projection 12, the height of which is such that it extends beyond the free end of the connecting piece 7 and the ring 8 when the device 2 is mounted on the tank 1.



The material of which the filling 11 is made is capable of deadening a knock or an impact thanks to its compressibility, it being possible for this material to be expanded polystyrene, polyurethane foam or any other expanded synthetic material.

Because of its shape which envelopes not only the dome 1b but also said portion of the wall 1a, and because of the filling 11 which occupies the entirety of the space between said shell 10 and the wall of the tank 1, the device 2 spreads perfectly any impact that this tank may suffer.

Figure 2 more particularly shows that the projection 12 perfectly protects the connecting piece 7 and the ring 8, and therefore the wall of the tank 1, against any direct impact in the event of a "vertical" droppage.

Figure 3 shows that the rounded wall 10c and the maximum thickness of the filling 11 facing this wall 10c perfectly protect the part of the dome 1b which lies at the end corresponding to the wall 1a.

Figure 4, for its part, shows that the wall 10a provides the dome 1b and the wall 1a with prefect protection in the event of a "horizontal" droppage.

The connecting piece 7 and the ring 8 allow the device 2 to be mounted removably on the tank 1, so that this device 2 does not form any impediment to inspecting the wall of this tank 1.

The invention also provides a device that makes it possible to overcome the drawbacks of the corresponding devices of the prior art because it is simple and inexpensive to employ, does not make the container significantly heavier, and affords this container perfect protection in the event of a droppage, regardless of the angle formed between the axis of this

container and the impact surface.

It goes without saying that the invention is not restricted to the embodiment described hereinabove by way of example but that, on the contrary, it encompasses all alternative forms of embodiment thereof. Thus, in the case of small-sized containers such as bottles, the exterior side face of the projection 12 could be in the continuation of the wall 10a.